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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/616,044	07/08/2003	Michael X. Yang	AMAT/7669.P2/CMP/ECP/RKK	9799

44257 7590 12/21/2005

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EXAMINER	
VAN, LUAN V	

ART UNIT	PAPER NUMBER
1753	

DATE MAILED: 12/21/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/616,044	YANG ET AL.	
	Examiner	Art Unit	
	Luan V. Van	1753	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *31 October 2005*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-31* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-31* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Response to Amendment

Applicant's amendment of October 31, 2005 does not render the application allowable.

The amendment filed October 6, 2005 is objected to under 35 U.S.C. 132(a) because it introduces new matter into the disclosure. 35 U.S.C. 132(a) states that no amendment shall introduce new matter into the disclosure of the invention. The added material which is not supported by the original disclosure is as follows: the claims 29-31 are amended to recite the limitation of "wherein the ionic membrane positioned in a vertical position above the anode and in substantially parallel relationship to an upper surface of the anode" (claim 29), and the limitation of "the anode is tilted between about 3° and about 30° from horizontal (claim 31). However, there is no evidence in the applicant's disclosure to support the recitation of the limitations above. The disclosure teaches on page 8 that the components of the plating cell are tilted but does not explicitly say that the anode is tilted. The disclosure, therefore, does not provide a clear indication to support the new limitations. Applicant is required to cancel the new matter in the reply to this Office Action.

Status of Objections and Rejections

The objection to the drawings has been withdrawn in view of Applicant's amendment.

The objection to the claims has been withdrawn in view of Applicant's amendment.

All rejections from the previous office action are withdrawn in view of Applicant's amendment.

New rejections under 35 U.S.C. 103(a) are necessitated by the amendments.

Claim Rejections - 35 USC § 112

The following is a quotation of the first paragraph of 35 U.S.C. 112:

> The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

Claims 29-31 are rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention. The claims 29-31 are amended to recite the limitation of "wherein the ionic membrane positioned in a vertical position above the anode and in substantially parallel relationship to an upper surface of the anode" (claim 29), and the limitation of "the anode is tilted between about 3° and about 30° from

horizontal (claim 31). However, there is no evidence in the applicant's disclosure to support the recitation of the limitations above. The disclosure teaches on page 8 that the components of the plating cell are tilted but does not explicitly say that the anode is tilted. The disclosure, therefore, does not provide a clear indication to support the new limitations.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

The factual inquiries set forth in *Graham* **v.** *John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

Claims 1-3, 5-10, 13-14, 19-27 and 29 are rejected under 35 U.S.C. 103(a) as being unpatentable over Mayer et al. in view of Reid et al.

Regarding claims 1, 6, 10, 17, 19-20, 22, 25-26 and 29, Mayer et al. teach a method for plating copper onto a substrate, comprising: positioning the substrate in a catholyte solution (column 19 lines 16-23), the solution comprising: an acid source at a concentration of between about 0-250 g/L (column 20 lines 11-15); a copper source at a concentration of between about 10-50 g/L (or about 0.2-0.8 M, column 20 lines 5-15); one or more additives (column 19 lines 16-28); and hydrochloric acid (column 20 lines 11-15); and applying a plating bias between the substrate and an anode (column 4 lines 5-10). The anolyte also has the same concentration of copper of 10-50 g/L (column 4 lines 28-31). The ranges of concentration as taught by Mayer et al. are within the ranges of the instant claims. Regarding the limitation of the anolyte copper concentration of "greater than about 51 g/L", a prima facie case of obviousness exists where the claimed ranges and the prior art ranges do not overlap but are close enough that one skilled in the art would have expected them to have the same properties" MPEP 2144.05. In addition, Mayer et al. teach that the anolyte in the anode chamber is substantially free of organic additives (column 7 lines 14-17).

The difference between the reference to Mayer et al. and the instant claims is that the reference does not explicitly teach the specific concentration of the chloride ions of the instant claim (claims 1, 25); nor the pH of the anolyte solution (claim 19).

Reid et al. teach a method for plating copper onto a substrate, comprising: positioning the substrate in a solution (paragraph 21), the solution comprising: an acid

source at a concentration of between about 0-300 g/L (Table 1); a copper source at a concentration of between about 10-60 g/L (or about 0.16-0.94 M); and chlorine ions at a concentration of between about 20-200 mg/L (or about 20-200 ppm); and applying a plating bias between the substrate and an anode (paragraphs 24-25). The ranges of concentration as taught by Reid et al. are within the ranges of the instant claims.

Addressing claims 1, 17, 22 and 25, it would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the electroplating method of Mayer et al. by using the chloride ion concentration of Reid et al., because such concentration is suitable for electroplating to produce metal films and features without voids or defects (paragraph 7).

Addressing claims 5, 19 and 27, Mayer et al. teach that either a low acid formulation or a high acid formulation can be used (column 4 lines 33-40). It would have been obvious to one having ordinary skill in the art that using a low acid formulation would yield a solution having the pH of the instant claims, since the acid concentration is within the range of the instant claims.

Regarding claim 2 and 23, Mayer et al. teach an electroplating method wherein the solution further comprises: levelers, suppressors; and accelerators (column 19 lines 16-28). The difference between the reference to Mayer et al. and the instant claims is

that the reference does not explicitly teach the specific concentration of the instant claim.

Reid et al. teach an electroplating method wherein the solution further comprises: a leveler at a concentration of between about 0.5-8 ml/L (Table 1); a suppressor at a concentration of between about 1-6 ml/L; and an accelerator at a concentration of between about 0.5-8 ml/L. The ranges of concentration as taught by Reid et al. are within the ranges of the instant claims.

It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the electroplating method of Mayer et al. by using the additive concentrations of Reid et al., because such concentration is suitable for electroplating to produce metal films and features without voids or defects (paragraph 7).

Regarding claim 3, Mayer et al. teach an electroplating method wherein the suppressor comprises polyethylene oxide and propylene oxide (column 19 claims 38-45).

Regarding claim 8 and 21, Mayer et al. teach that the membrane "allows both anions and cations to move freely through the membrane and have properties of minimal added resistance to electrical flow" (column 17 lines 43-47). It would have

been obvious to one having ordinary skill in the art that the membrane of Mayer et al. provides a copper transport of copper ions through the ionic membrane of between about 90% and about 100%, because the anions and cations are moving freely through the membrane.

Regarding claim 9 and 24, Mayer et al. teach an electroplating method wherein the anode comprises a copper anode (column 20 claims 35-37).

Regarding claims 13-14, Mayer et al. teach an electroplating method wherein a diffusion member 466 in figure 4B is positioned between an upper surface of the ionic membrane and the substrate and that the diffusion member comprises a porous ceramic disk (column 13 lines 49-56).

Claims 15-16, 28 and 30 are rejected under 35 U.S.C. 103(a) as being unpatentable over Mayer et al. in view of Reid et al., and further in view of Woodruff et al.

Mayer et al. teach the method as described above. Mayer et al. does not explicitly teach an electroplating method wherein the ionic membrane comprises a membrane having a fluorized polymer matrix nor a membrane having a polydivinilbenzol matrix.

Woodruff et al. disclose an electroplating apparatus with a NAFION perfluorinated membrane that is permeable to cations, but reject anions and non-polar species in order to eliminate the consumption of additives at the anodes (paragraphs 87-88)

It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the electroplating method of the one by using the membrane of Woodruff et al., because the perfluorinated membrane would reduce the consumption of additives. It would have been obvious to one having ordinary skill in the art to have used a polydivinilbenzol matrix, because Mayer et al. teach that any suitable porous polymeric materials can be used (column 16 lines 51-63).

Claims 4, 11, 12, 17 and 18 are rejected under 35 U.S.C. 103(a) as being unpatentable over Mayer et al. in view of Reid et al., and further in view of Dahms et al.

Mayer et al. teach the electroplating method as described above.

Regarding claim 4, Mayer et al. do not explicitly teach an electroplating method wherein the accelerator comprises sulfo propyldisulfide.

Dahms et al. teach an electroplating method for copper having an accelerator comprising of bis-(w-sulfopropyl)-disulfide, disodium salt (Table 2).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the combined method of Mayer et al. and Reid et al. by using the accelerator of Dahms et al., because a sulfo propyldisulfide accelerator is a suitable additive for electroplating copper.

Regarding claim 11, the references do not explicitly teach an electroplating method wherein the copper concentration is supplied by copper sulfate pentahydrate.

Dahms et al. teach an electroplating method for copper using copper sulfate pentahydrate having a concentration of 20-250 g/L (or about 0.08-1.0 M; column 8 lines 5-15), which is within the reach of the instant claim.

It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the combined method of Mayer et al. and Reid et al. by using the copper sulfate pentahydrate of Dahms et al., because copper sulfate pentahydrate is suitable for electroplating copper.

Regarding claim 12, Mayer et al. teach that either a low acid formulation or a high acid formulation can be used (column 4 lines 33-40). It would have been obvious to one having ordinary skill in the art that using a low acid formulation would yield a solution

having the pH of the instant claims, since the acid concentration is within the range of the instant claims.

Regarding claim 17, the difference between the reference to Mayer et al. and the instant claims is that the reference does not explicitly teach the specific concentration of the chloride ions of the instant claim.

Reid et al. teach a method for plating copper onto a substrate, comprising: positioning the substrate in a solution (paragraph 21), the solution comprising: an acid source at a concentration of between about 0-300 g/L (Table 1); a copper source at a concentration of between about 10-60 g/L (or about 0.16-0.94 M); and chlorine ions at a concentration of between about 20-200 mg/L (or about 20-200 ppm); and applying a plating bias between the substrate and an anode (paragraphs 24-25). The ranges of concentration as taught by Reid et al. are within the ranges of the instant claims.

It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the electroplating method of Mayer et al. by using the chloride ion concentration of Reid et al., because such concentration is suitable for electroplating to produce metal films and features without voids or defects (paragraph 7).

Regarding claim 18, Mayer et al. teach an electroplating method wherein the solution further comprises: levelers, suppressors; and accelerators (column 19 lines 16-28). The difference between the reference to Mayer et al. and the instant claims is that the reference does not explicitly teach the specific concentration of the additives of the instant claim.

Reid et al. teach an electroplating method wherein the solution further comprises: a leveler at a concentration of between about 0.5-8 ml/L (Table 1); a suppressor at a concentration of between about 1-6 ml/L; and an accelerator at a concentration of between about 0.5-8 ml/L. The ranges of concentration as taught by Reid et al. are within the ranges of the instant claims.

It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the electroplating method of Mayer et al. by using the additive concentrations of Reid et al., because such concentration is suitable for electroplating to produce metal films and features without voids or defects (paragraph 7).

Claims 31 is rejected under 35 U.S.C. 103(a) as being unpatentable over Mayer et al. in view of Reid et al., and further in view of Sendai et al..

Mayer et al. teach the method as described above. The difference between the reference to Mayer et al. and the instant claims is that the reference does not explicitly teach tilting the anode.

Sendai et al. teach a method and apparatus for tilting the anode at an angle from 1-10° with respect to the horizontal plane so as to be parallel to the substrate (paragraph 91).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the electroplating method of Mayer et al. by tilting the anode as taught by Sendai et al., because it would improve the uniformity of the metal film (paragraph 90).

Response to Arguments

Applicant's arguments filed October 31, 2005 have been fully considered but they are not persuasive.

In the arguments presented on page 21 of the amendment, the applicant argues that Reid et al. does not disclose using a membrane and thus creating a catholyte chamber and an anolyte chamber. The examiner agrees that it would not have been obvious to modify Reid et al., and thus the rejections under 35 U.S.C. 103(a) using Reid

et al. as the primary reference have been withdrawn. Claims 1, 10, 19 and 25 have also been substantially amended by the applicant to recite the limitations that only the catholyte solution contains the additives. New rejections under 35 U.S.C. 103(a) are necessitated by the amendments.

As described above, the claims are now rejected under 35 U.S.C. 103(a) as being unpatentable over Mayer et al. in view of Reid et al. Mayer et al. teach a method for plating copper onto a substrate, comprising: positioning the substrate in a catholyte solution (column 19 lines 16-23), the solution comprising: an acid source at a concentration of between about 0-250 g/L (column 20 lines 11-15); a copper source at a concentration of between about 10-50 g/L (or about 0.2-0.8 M, column 20 lines 5-15); one or more additives (column 19 lines 16-28); and hydrochloric acid (column 20 lines 11-15); and applying a plating bias between the substrate and an anode (column 4 lines 5-10). The anolyte also has the same concentration of copper of 10-50 g/L (column 4 lines 28-31). In addition, Mayer et al. teach that the anolyte in the anode chamber is substantially free of organic additives (column 7 lines 14-17). The difference between the reference to Mayer et al. and the instant claims is that the reference does not explicitly teach the specific concentration of the chloride ions of the instant claim.

Reid et al. teach a method for plating copper onto a substrate, comprising: positioning the substrate in a solution (paragraph 21), the solution comprising: an acid source at a concentration of between about 0-300 g/L (Table 1); a copper source at a

concentration of between about 10-60 g/L (or about 0.16-0.94 M); and chlorine ions at a concentration of between about 20-200 mg/L (or about 20-200 ppm); and applying a plating bias between the substrate and an anode (paragraphs 24-25). The ranges of concentration as taught by Reid et al. are within the ranges of the instant claims. Although Reid et al. does not disclose using a membrane, the copper plating solution of Reid et al. is the equivalent to the catholyte solution of Mayer et al., since the composition of the solutions is the same and both solutions are directed toward copper plating. Thus, substituting the solution of Mayer et al. for another suitable equivalent for electroplating copper is prima facie obviousness. Similarly, the rejection over Mayer et al. in view of Dahms et al. is appropriate for the same reasoning.

It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the electroplating method of Mayer et al. by using the chloride ion concentration of Reid et al., because such concentration is suitable for electroplating to produce metal films and features without voids or defects (paragraph 7). Furthermore, changes in temperature or concentration will not support the patentability of subject matter unless there is evidence indicating such temperature or concentration is critical. It is not inventive to discover the optimal or workable ranges by routine experimentation (MPEP 2144.05).

In the arguments presented on page 22 of the amendment, the applicant argues that the anolyte of Woodruff et al. includes the additives. The examiner respectfully

disagrees. Woodruff et al. teach that the ionic membrane "allows electrical current to pass through the interface member while filtering out particles, organic additives and bubbles in the fluid.... A benefit of having separate anolyte and catholyte fluid flows is that it eliminates the consumption of additives at the anodes and the need to replenish the additives as often" (paragraph 88). This clearly suggests that the additives are not in the anolyte. However, even assuming that the additives are in the anolyte of Woodruff et al., the rejection of Mayer et al. in view of Woodruff et al. is still proper, because Mayer et al. already teach that the anolyte in the anode chamber is substantially free of organic additives (column 7 lines 14-17). It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the electroplating method of the one by using the membrane of Woodruff et al., because the perfluorinated membrane would reduce the consumption of additives, and because substituting one polymeric membrane for another suitable equivalent is prima facie obviousness.

Applicants' arguments with respect to the references of Dordi et al., Horkans et al., Landau et al. '522 and Landau et al. '433 (U.S. 6261433) have been considered but are moot in view of the new ground(s) of rejection.

Conclusion

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP §

706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Luan V. Van whose telephone number is 571-272-8521. The examiner can normally be reached on M-F 8:30-5:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nam Nguyen can be reached on 571-272-1342. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

LVV
12/14/2005

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